CHAPTER 4

SLOPE STABILIZATION PRACTICES

BMP 4-1
SLOPE SHAPING

DEFINITION

Slope shaping is comprised of designing and modifying cut or fill slopes to reduce the soil erosion and runoff potential. Slope shaping activities include: pre-disturbance planning and design, terraces, benches, serrations, and steps.

PURPOSE

The goals of slope shaping include: reducing steep and unstable slopes; reducing velocity and surface runoff; and increasing the distance of overland flow which results in increased infiltration and sediment collection. Additionally, slope shaping is required to create a stable environment for the establishment of plant species.

APPLICABILITY

Slope shaping activities are applicable to any cut of fill slope and should be considered up front in the planning and design phase of a surface disturbance project (i.e. development, mining, construction, etc.).

PLANNING CRITERIA

The design of slope shaping activities is typically done by qualified engineers during the design phase of a project. Slope shaping is utilized in conjunction with other sediment and erosion control structures or treatments. Slope stability and the stability of the soils or excavated materials is critical to the design of appropriate slope shaping activities. Contributing watershed, length of slope, stability, drainageways, etc. all must be considered in the design. Slopes greater than 3:1 typically required stair-stepping or terraces to create shorter, gentler slope lengths. Permanent establishment of vegetation slopes greater than 3:1 is difficult and requires comprehensive planning.

METHODS AND MATERIALS

A qualified engineer should be consulted for the design, location and construction of slope shaping treatments. The following discussion identifies the basics of slope shaping treatments.

Terraces reduce the slope length, allow for drainage, sediment control and create flat areas for vegetation establishment. Terraces are comprised of benches, steps and serrations. Benches generally refer to wide horizontal, level or slightly reverse sloping terraces. Benches range from 10 to 20 feet wide and accommodate construction equipment and drainage conveyance.

They also provide access for maintenance activities until vegetation establishment. Steps are usually horizontal and range from two to four feet. They are typically cut into a slope by heavy equipment as a road is constructed. Serrations are typically ten inches wide and are cut by a special attachment on a bulldozer or grader.

MAINTENANCE

Regular maintenance is important to the functionablity of slope shaping activities. Inspections should be conducted on a regular basis, particularly after precipitation or storm runoff events. Accumulated sediment must be collected and removed. Sloughing is possible so those areas should be watched carefully and repaired as necessary.

EFFECTIVENESS

Slope shaping activities are effective if applied correctly given the site specific soils and conditions of the site.

BMP 4-2
RETAINING STRUCTURES

DEFINITION

Retaining structures are walls comprised of wood, rock concrete or other material, constructed at the toe of a slope.

PURPOSE

Retaining structures stabilize a slope against mass movement, protect the slope face or toe from scour and erosion from storm runoff, and allow reduction in the degree of slope for revegetion efforts, (i.e. plant material establishment).

APPLICABILITY

Applicable to all cut or fill slopes which can not be regraded due to specific site conditions. Retaining structures are typically utilized at the base of slopes, adjacent to roadways, structures, or drainageways. Retaining structures are always utilized in conjunction with other reclamation, revegetation and erosion control treatments to stabilize the affected slope.

PLANNING CRITERIA

The expertise of qualified professionals is required, as a variety criteria and data is needed to properly design and install retaining structures. The specifics of a given project area will guide the type and design of a retaining structure.

METHODS AND MATERIALS

Retaining structures can be built from a variety of materials, both natural and artificial. Natural materials include: rock, stone timber and earth. Artificial materials include steel and concrete which is stronger but more expensive. Combinations of both natural and artificial materials are also utilized such as gabion walls and welded wire walls. Retaining structures include:

- Gravity Walls
- Reinforced Earth
- Wood Walls
- Tie-Back Walls
- Crib or Bin Walls
- Gabions and Welded Wire
- Pile Walls
- Cantilever and Counterfort Walls

Structures can be designed specifically for the site in a manner which is both structurally sound and aesthetically pleasing.

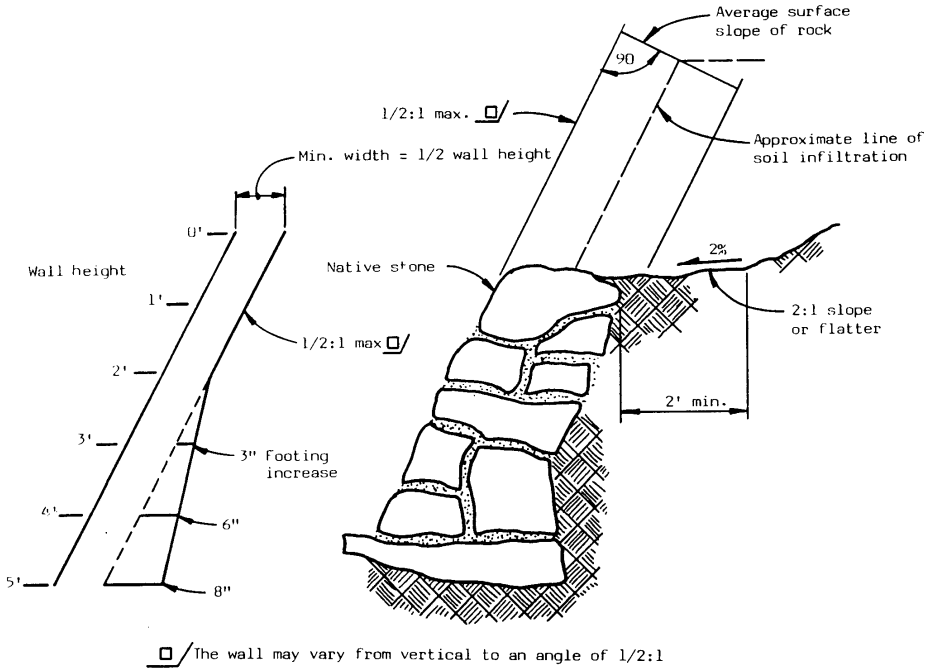
MAINTENANCE

If properly installed, retaining structures require little maintenance unless damaged. Periodic inspections should be made and repairs conducted immediately.

EFFECTIVENESS

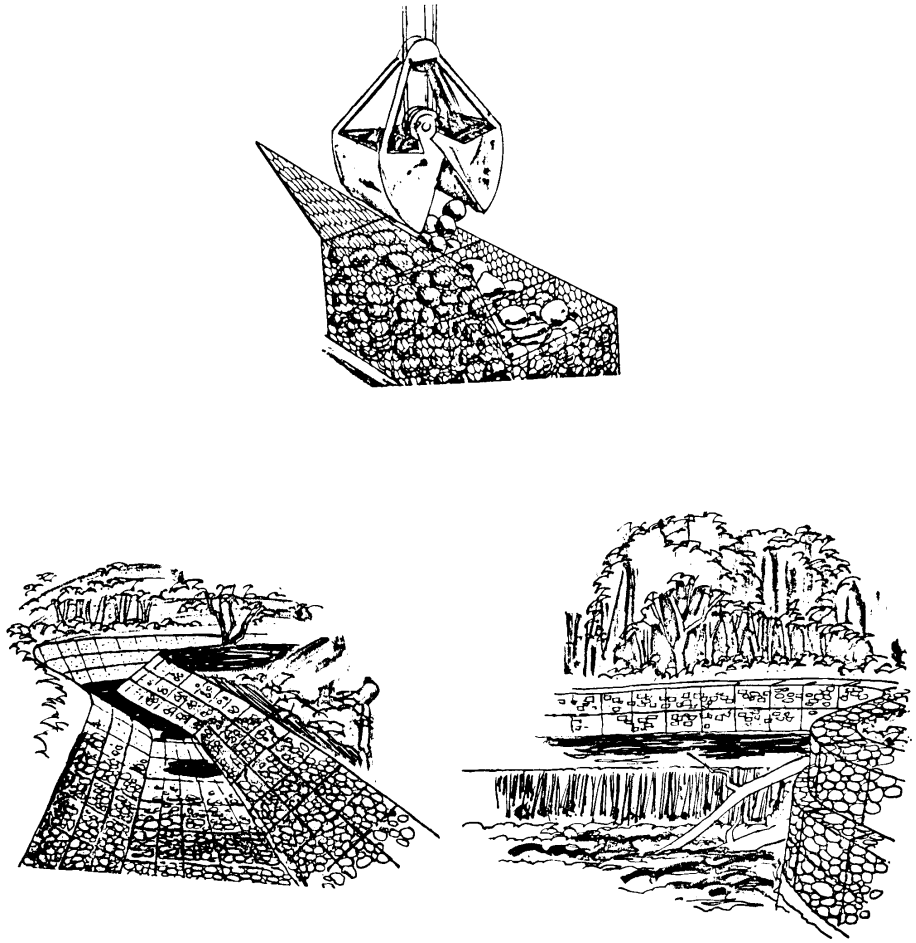
Retaining structures are very effective for controlling soil erosion and providing slope stability when properly designed and installed. They are most effective when utilized in conjunction with revegetation practices.

NATIVE ROCK RETAINING WALL
FIGURE 4-1



NATIVE ROCK RETAINING WALL

RETAINING WALLS
FIGURE 4-2



Gabions usefull to stabilize channels and for retaining walls.

BMP 4-3
ROCK RIPRAP

DEFINITION

Rock riprap is a layer of loose rock placed over an erodible soil or surface disturbance.

PURPOSE

To protect the soil surface, to provide for slope stabilization on steep slopes and to reduce soil erosion within a project area.

APPLICABILITY

Rock riprap is primarily utilized in drainage stabilization projects such as channel and ditch linings and energy dissipators. Rock riprap is used on steep, difficult slopes where vegetation has not been successful. Seed, shrubs and trees have been incorporated with rock riprap by interplanting.

PLANNING CRITERIA

A source of rock riprap of the appropriate size and the associated transportation costs are the primary planning criteria. Depending upon the application, rock riprap can be utilized with revegetation efforts but the establishment of permanent vegetation is preferred for long term stability and maintenance. Rock riprap applied to active drainageways or channels usually requires an underlining of matting or fabric to prevent erosion.

METHODS AND MATERIALS

The rock riprap should be sound, dense and durable rock with a specific gravity of not less than 2 1/2 and greater than 12 inches in diameter. Seeding should occur prior to rock placement. If to be used within an active drainage channel, a synthetic mat or fabric should be installed prior to rock placement. Depending on the specifics of the site rock riprap can be placed by hand or by equipment. Existing trees and vegetation should be protected and rock riprap placed by hand in these areas. Rocks should be securely bedded and homogeneous in the layering. Depth of application depends upon the size of the drainageway, slope degree and length and the other specifics of the site.

MAINTENANCE

Little maintenance is required when rock riprap is installed properly. Periodic inspections should be made and any dislodged rocks replaced as required.

EFFECTIVENESS

Rock riprapping is an effective means of reducing soil erosion in channels and drainageways. Steep slope applications should be done in conjunction with revegetation practices. Rock riprap can be expensive depending upon the source and transportation costs.